Committee on Resources

Testimony

Subcommittee on Water and Power
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EVALUATION OF OPTIONS FOR REMEDIATION

OF THE SALTON SEA

Testimony before the

Subcommittee on Water and Power

U.S. House of Representatives Committee on Resources

October 3, 1997

SUMMARY AND CONCLUSIONS

Los Alamos National Laboratory has been providing technical support for the remediation of the ecological problems in the Salton Sea. Environmental issues related to the Salton Sea include:

- industrial and municipal waste,
- selenium concentrations,
- high salinity, and
- variable water levels.

Based on our analysis, we conclude that:

Industrial and municipal waste in the Salton Sea will be reduced considerably once the Mexicali treatment facility is operational around the Year 2000.

There is time to address the selenium issue, allowing for further research and more information to be gathered.

Desalination is not a viable concept for salinity and elevation control of the Salton Sea.

"Pump-out" is a feasible method for salinity control, but the size of the Salton Sea would decrease.

"Diked impoundment" will control salinity and elevation, but the impoundment area would have high salinity water.

Diked impoundment appears to be the solution which best meets the salinity and elevation requirements--and at a similar cost to "pump-out."

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INTRODUCTION

In May of this year Los Alamos National Laboratory was asked by the Congressional Salton Sea Task Force to provide technical support for the remediation of the ecological problems in the Salton Sea. Today I am going to report on some of our work in evaluating various concepts for remediating the Sea. Our results are preliminary and in some cases qualitative, but they can be used to help guide decision-makers such as yourselves in your deliberations. *Ultimately, selecting the "best" solution for saving the Salton Sea will have to integrate performance, economic, ecological, and institutional factors into the decision.*

Environmental issues related to the Salton Sea *are well known and* include

- industrial and municipal waste,
- selenium concentrations,
- high salinity, and
- variable water levels.

Today I am going to briefly discuss each of these issues.

INDUSTRIAL AND MUNICIPAL WASTE

The primary source of industrial and municipal waste to the Salton Sea is untreated sewage from Mexicali. However, although the amount of industrial and municipal waste discharged to the New River is large, *its impact on the Salton Sea is reduced during its 50-mile journey to the Sea. Furthermore,* plans are in the works for a Mexicali treatment facility which, when completed around the Year 2000, will help alleviate this problem.

Consequently, we feel that the issue of industrial and municipal waste pollution in the Salton Sea is already being addressed. *However, the impact of nutrients in agricultural return flows on the industrial and municipal waste needs further research.*

SELENIUM

Because the agricultural drain water entering the Salton Sea contains selenium there is concern that this may cause selenium poisoning problems in the Salton Sea and may be contributing to the bird and fish die-offs. *The health effects of human, fish, and waterfowl exposure to water and to sediments containing specific levels of selenium are not well known. The Environmental Protection Agency recommends that drinking water should not exceed more than 10 ppb and the Food and Drug Administration allows up to the same level in bottled drinking water.*

Information provided to us *by the Salton Sea Authority* on measurements of selenium concentrations in the drain water, Sea water, and sediments in the Salton Sea indicate levels that are below the existing EPA *and FDA* recommendations in the case of Salton Sea water and are typically a factor of ten or more below those experienced at the Kesterson National Wildlife Refuge.

Therefore, we do not view selenium in the Salton Sea as a pressing problem and think that additional research on selenium and its impact on the environment of the Salton Sea is needed before any actions are undertaken. Also, the selenium levels in the Salton Sea and its sediments need to be carefully monitored so that any trends toward increasing selenium levels will be detected early.

HIGH SALINITY AND VARIABLE WATER LEVELS

The remaining two issues, high salinity and variable water levels, are complicated and most solutions will impact both these problems to varying degrees. Regarding salinity, the Salton Sea Authority has set a goal of 35 parts per thousand (ppt), which is equal to the salt content of ocean water, and a decrease of about 9 ppt from the current level. The Authority would like to stabilize the water level at between -230 and -235 feet, which is a slight decrease from today's elevation of about -227 feet.

Los Alamos has examined the cost, salinity, and Sea level changes of three remediation concepts:

desalination;

pump-in; pump-out; and

diked impoundment

and compared these results with "doing nothing." We have concentrated on performance and economic issues and have not evaluated ecological or institutional factors in this analysis.

The purpose of this work is to determine the primary advantages and disadvantages of each concept. For each concept, there are numerous variations, so detailed engineering designs must be completed once a concept is selected.

The assumptions for our analysis are:

due to anticipated water conservation, the inflow into the Salton Sea will linearly decrease from the present flow of 1.3 million acre-feet per year (MAF/year) to 1.0 MAF/year over a twenty year period.

the salinity level of the inflow to the Sea will increase from the present 2.3 ppt to 3.0 ppt over the same time period.

The "water and salt balance" model that we used is a fairly simple computer simulation that calculates elevation, surface area, volume, and salinity. The model also takes into account changes in evaporation rate due to changes in salinity and surface area.

Do Nothing

First, if no action is taken the Salton Sea will, of course, continue to increase in salinity from today's level of 44 ppt. *Figure 1*. The Sea would reach a salinity level of about 60 ppt in about 15 years. This is important because some believe that most fish can no longer live in water around this salinity level. Therefore, there isn't much time if the Salton Sea is to be saved. *The salinity level would reach almost 100 ppt in 30 years, and after 50 years would approach 120 ppt.*

Regarding water level, the elevation of the Sea would be lowered from today's -227 feet to -242 feet after 30 years. This 15 foot drop in elevation would result in a reduction in the Sea's surface area by approximately 20%--from about 380 sq. miles to 304 sq. miles.

Desalination

If there were an inexpensive filtering or distillation method to remove salt from high-salinity water, desalination would be an obvious solution to the problems of the Salton Sea. The process could be used to reduce the salinity of the water already in the Salton Sea, or to desalinate ocean water being pumped from the Gulf of California as part of a "pump-in, pump-out" scheme.

If desalination is used to freshen the water in the New, Alamo, and Whitewater Rivers and the water allowed to flow into the Salton Sea, this reduces the quantity of salt going into the Sea but does not solve the salinity problem because salt is not being removed from the Sea. Furthermore, if the desalinated water is diverted instead of flowing into the Salton Sea, this will lower the Sea's elevation and increase its salinity thereby making the problem worse.

One desalination proposal was developed earlier this year by U.S. Filter. They propose treating New and Alamo River water prior to entering the Salton Sea and diverting about 160 TAF/year for recycle. *The saline water, 45 TAF/year, would be disposed of, in addition to 22 TAF/year of water which would be pumped out of the Salton Sea for a total water loss to the Sea of 227 TAF/year (160 + 45 + 22). U.S. Filter* *estimates that the total project capital cost would be between $750 million and $1.0 billion.*

The impact of the above proposal on the salinity of the Salton Sea is an increase to about 120 ppt at 30 years, which is 20 ppt higher than doing nothing. *Figure 2*. Furthermore, the surface area of the Sea would decrease by over 30%, *to about 260 square miles, and the elevation would decrease to -250 feet*.

Another proposal, by the Metropolitan Water District (MWD), would divert approximately 450 TAF/year of Alamo *(390)* and Whitewater *(60)* River water. *After desalination, the water would be delivered to the Colorado River Aqueduct. MWD estimates the capital cost would be $1.1 billion with operation costs of $58 million/year*. Once again, from the point of view of remediating the Salton Sea, this makes the Sea smaller and saltier.

In summary, desalination can be used to produce fresh water for urban use, but proposals that divert inflow water will make the Salton Sea salinity and elevation problems worse. *There are, of course, other desalination approaches which could improve the Salton Sea, but we feel these would be prohibitively expensive*.

Pump-In, Pump-Out

Another concept that has received attention consists of pumping water from an external source to the Salton Sea and pumping water from the Sea to an external location. The advantage of such a concept is that it has the potential to allow simultaneous control of salinity, elevation, and surface area.

The obvious source for pump-in water is the Gulf of California which, of course, is at ocean water salinity. However, for this concept to be practical, the salinity of the pump-in water needs to be considerably less than that of ocean water in order for the Salton Sea to eventually reach ocean water salinity. If the pump-in water is at ocean water salinity, very large quantities of water must be pumped, both in and out. For example, pumping in 400 TAF/year of ocean water and pumping out 500 TAF/year of Salton Sea water is required for the Salton Sea to approach ocean water salinity. *Figure 3. The elevation of the Sea would stabilize at about -250 feet for this scenario. Figure 4. Our estimate is that the capital cost for such a system would be about $1.7 billion, with another $30 million per year in operating costs (assuming electricity costs of 3.5 /kWh).*

Since it is unlikely there will be a source of low-salinity pump-in water, a variation of this concept is "pump-out" only. Pumping out a relatively small 150 TAF/year of Salton Sea water will allow the Salton Sea to reach ocean salinity. *Figure 5*. This would create a smaller Salton Sea by about 35% *(to 245 square miles) with an elevation of about -253 feet, or just a few feet lower than pumping in 400 TAF/year and pumping out 500 TAF/year*. Our estimate of the capital cost for this system is about $300 million, with operating costs being approximately $5 million per year.

Therefore, "pump-out" achieves nearly the same results as "pump-in, pump-out," and at a much lower cost. Providing that a smaller Salton Sea is acceptable, "pump-out" should be considered as a viable option for the Salton Sea. One important issue that needs to be resolved with this concept is the destination of the pumped water. One frequently mentioned area is the Laguna Salada in Mexico. Technically this is feasible, but would entail reaching an agreement with Mexico.

Diked Impoundment

Another concept that has the potential for controlling salinity and elevation is the creation of in-Sea impoundment areas by diking. This could result in a Salton Sea with the same elevation as now and a salinity level comparable to that in the ocean. The primary disadvantage of "diked impoundment" is that part of the surface area in the Sea would be in an impoundment area which would contain very saline water. Fish would not be able to survive in the impoundment, and in time this brine would precipitate salt.

Eventually, this salt would have to be removed from the impoundment area--the cheapest way probably being to pump out the brine. When this has to be done is uncertain and will depend on the criteria for pumping out the brine. A lower bound would be when the brine first reaches saturation while the upper bound would be when the impoundment area fills up with solid salt.

Using our assumptions on inflow volumes, an impoundment area of approximately 65 square miles (about 17% of the area of the Salton Sea) would allow the Salton Sea to reach ocean salinity. *Figure 6*. Depending on the pumping criterion, the impoundment would be able to operate from 10 to 75 years before the brine needs to be pumped out. Our estimate of the capital cost of such a system is about $300 million for an earthen dike and about $700 million for a concrete dam. Operation costs would be $1-2 million/year.

If the impoundment area is increased to approximately 25% of the Salton Sea (about 95 square miles), the salinity decreases to about 25 ppt. In this case, pumping the brine could be delayed from 15 to 125 years.

If having part of the Salton Sea at a high salinity level is acceptable, we feel that "diked impoundment" is also a viable option for the Salton Sea.

Comparison of Pump-Out and Diked Impoundment

Therefore, based on the above analyses we feel that the best solutions for salinity and elevation control of the Salton Sea are "pump-out" and "diked impoundment." It is possible to do a rough comparison of the physical characteristics and costs of these two concepts. To make the comparison more meaningful, we will use scenarios where each concept results in ocean water salinity level for the Salton Sea.

In either case, the surface of the Sea will change. For the case of "pump-out," the elevation would be reduced by about 25 feet with a corresponding decrease in surface area of about 35%. With "diked impoundment" the elevation and the total surface area would be about the same as it is today. However, the impoundment area would be about 17% of the total surface area, or roughly half the decrease in the surface area under the "pump-out" option.

The capital cost for "pump-out" would be approximately $300 million, assuming the Laguna Salada as the recipient of the water, which is about the same as "diked impoundment" using an earthen dam. Operation costs would be about $5 and $1-2 million/year, respectively.

Compared to "pump-out," another advantage of "diked impoundment" is that it does not require an immediate repository for high-salinity Salton Sea water.

CONCLUSIONS

Based on our analysis, we conclude that:

Industrial and municipal waste in the Salton Sea will be reduced considerably once the Mexicali treatment facility is operational around the Year 2000.

There is time to address the selenium issue, allowing for further research and more information to be gathered.

Desalination is not a viable concept for salinity and elevation control of the Salton Sea.

"Pump-out" is a feasible method for salinity control, but the size of the Salton Sea would decrease.

"Diked impoundment" will control salinity and elevation, but the impoundment area would have high salinity water.

Diked impoundment appears to be the solution which best meets the salinity and elevation requirements--and at a similar cost to "pump-out." More detailed and optimized designs need to be developed in order to better predict cost and performance. Finally, the ecological and institutional consequences of the various concepts need to be better analyzed before a final selection is made.

Thank you.

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